

52. IWK

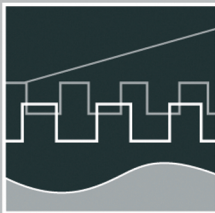
Internationales Wissenschaftliches Kolloquium
International Scientific Colloquium



PROCEEDINGS

| 10 - 13 September 2007

FACULTY OF COMPUTER SCIENCE AND AUTOMATION



COMPUTER SCIENCE MEETS AUTOMATION

VOLUME I

Session 1 - Systems Engineering and Intelligent Systems

Session 2 - Advances in Control Theory and Control Engineering

**Session 3 - Optimisation and Management of Complex
Systems and Networked Systems**

Session 4 - Intelligent Vehicles and Mobile Systems

Session 5 - Robotics and Motion Systems



Bibliografische Information der Deutschen Bibliothek

Die Deutsche Bibliothek verzeichnet diese Publikation in der deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über <http://dnb.ddb.de> abrufbar.

ISBN 978-3-939473-17-6

Impressum

- Herausgeber: Der Rektor der Technischen Universität Ilmenau
Univ.-Prof. Dr. rer. nat. habil. Peter Scharff
- Redaktion: Referat Marketing und Studentische Angelegenheiten
Kongressorganisation
Andrea Schneider
Tel.: +49 3677 69-2520
Fax: +49 3677 69-1743
e-mail: kongressorganisation@tu-ilmenau.de
- Redaktionsschluss: Juli 2007
- Verlag: 
Technische Universität Ilmenau/Universitätsbibliothek
Universitätsverlag Ilmenau
Postfach 10 05 65
98684 Ilmenau
www.tu-ilmenau.de/universitaetsverlag
- Herstellung und Auslieferung: Verlagshaus Monsenstein und Vannerdat OHG
Am Hawerkamp 31
48155 Münster
www.mv-verlag.de
- Layout Cover: www.cey-x.de
- Bezugsmöglichkeiten: Universitätsbibliothek der TU Ilmenau
Tel.: +49 3677 69-4615
Fax: +49 3677 69-4602

© Technische Universität Ilmenau (Thür.) 2007

Diese Publikationen und alle in ihr enthaltenen Beiträge und Abbildungen sind urheberrechtlich geschützt. Mit Ausnahme der gesetzlich zugelassenen Fälle ist eine Verwertung ohne Einwilligung der Redaktion strafbar.

Preface

Dear Participants,

Confronted with the ever-increasing complexity of technical processes and the growing demands on their efficiency, security and flexibility, the scientific world needs to establish new methods of engineering design and new methods of systems operation. The factors likely to affect the design of the smart systems of the future will doubtless include the following:

- As computational costs decrease, it will be possible to apply more complex algorithms, even in real time. These algorithms will take into account system nonlinearities or provide online optimisation of the system's performance.
- New fields of application will be addressed. Interest is now being expressed, beyond that in "classical" technical systems and processes, in environmental systems or medical and bioengineering applications.
- The boundaries between software and hardware design are being eroded. New design methods will include co-design of software and hardware and even of sensor and actuator components.
- Automation will not only replace human operators but will assist, support and supervise humans so that their work is safe and even more effective.
- Networked systems or swarms will be crucial, requiring improvement of the communication within them and study of how their behaviour can be made globally consistent.
- The issues of security and safety, not only during the operation of systems but also in the course of their design, will continue to increase in importance.

The title "Computer Science meets Automation", borne by the 52nd International Scientific Colloquium (IWK) at the Technische Universität Ilmenau, Germany, expresses the desire of scientists and engineers to rise to these challenges, cooperating closely on innovative methods in the two disciplines of computer science and automation.

The IWK has a long tradition going back as far as 1953. In the years before 1989, a major function of the colloquium was to bring together scientists from both sides of the Iron Curtain. Naturally, bonds were also deepened between the countries from the East. Today, the objective of the colloquium is still to bring researchers together. They come from the eastern and western member states of the European Union, and, indeed, from all over the world. All who wish to share their ideas on the points where "Computer Science meets Automation" are addressed by this colloquium at the Technische Universität Ilmenau.

All the University's Faculties have joined forces to ensure that nothing is left out. Control engineering, information science, cybernetics, communication technology and systems engineering – for all of these and their applications (ranging from biological systems to heavy engineering), the issues are being covered.

Together with all the organizers I should like to thank you for your contributions to the conference, ensuring, as they do, a most interesting colloquium programme of an interdisciplinary nature.

I am looking forward to an inspiring colloquium. It promises to be a fine platform for you to present your research, to address new concepts and to meet colleagues in Ilmenau.



Professor Peter Scharff
Rector, TU Ilmenau



Professor Christoph Ament
Head of Organisation

CONTENTS

	Page
1 Systems Engineering and Intelligent Systems	
A. Yu. Nedelina, W. Fengler DIPLAN: Distributed Planner for Decision Support Systems	3
O. Sokolov, M. Wagenknecht, U. Gocht Multiagent Intelligent Diagnostics of Arising Faults	9
V. Nissen Management Applications of Fuzzy Control	15
O. G. Rudenko, A. A. Bessonov, P. Otto A Method for Information Coding in CMAC Networks	21
Ye. Bodyanskiy, P. Otto, I. Pliss, N. Teslenko Nonlinear process identification and modeling using general regression neuro-fuzzy network	27
Ye. Bodyanskiy, Ye. Gorshkov, V. Kolodyazhniy, P. Otto Evolving Network Based on Double Neo-Fuzzy Neurons	35
Ch. Wachten, Ch. Ament, C. Müller, H. Reinecke Modeling of a Laser Tracker System with Galvanometer Scanner	41
K. Lüttkopf, M. Abel, B. Eylert Statistics of the truck activity on German Motorways	47
K. Meissner, H. Hensel A 3D process information display to visualize complex process conditions in the process industry	53
F.-F. Steege, C. Martin, H.-M. Groß Recent Advances in the Estimation of Pointing Poses on Monocular Images for Human-Robot Interaction	59
A. González, H. Fernlund, J. Ekblad After Action Review by Comparison – an Approach to Automatically Evaluating Trainee Performance in Training Exercise	65
R. Suzuki, N. Fujiki, Y. Taru, N. Kobayashi, E. P. Hofer Internal Model Control for Assistive Devices in Rehabilitation Technology	71
D. Sommer, M. Golz Feature Reduction for Microsleep Detection	77

F. Müller, A. Wenzel, J. Wernstedt A new strategy for on-line Monitoring and Competence Assignment to Driver and Vehicle	83
V. Borikov Linear Parameter-Oriented Model of Microplasma Process in Electrolyte Solutions	89
A. Avshalumov, G. Filaretov Detection and Analysis of Impulse Point Sequences on Correlated Disturbance Phone	95
H. Salzwedel Complex Systems Design Automation in the Presence of Bounded and Statistical Uncertainties	101
G. J. Nalepa, I. Wojnicki Filling the Semantic Gaps in Systems Engineering	107
R. Knauf Compiling Experience into Knowledge	113
R. Knauf, S. Tsuruta, Y. Sakurai Toward Knowledge Engineering with Didactic Knowledge	119
 2 Advances in Control Theory and Control Engineering	
U. Konigorski, A. López Output Coupling by Dynamic Output Feedback	129
H. Toossian Shandiz, A. Hajipoor Chaos in the Fractional Order Chua System and its Control	135
O. Katernoga, V. Popov, A. Potapovich, G. Davydau Methods for Stability Analysis of Nonlinear Control Systems with Time Delay for Application in Automatic Devices	141
J. Zimmermann, O. Sawodny Modelling and Control of a X-Y-Fine-Positioning Table	145
A. Winkler, J. Suchý Position Based Force Control of an Industrial Manipulator	151
E. Arnold, J. Neupert, O. Sawodny, K. Schneider Trajectory Tracking for Boom Cranes Based on Nonlinear Control and Optimal Trajectory Generation	157

K. Shaposhnikov, V. Astakhov The method of ortogonal projections in problems of the stationary magnetic field computation	165
J. Naumenko The computing of sinusoidal magnetic fields in presence of the surface with bounded conductivity	167
K. Bayramkulov, V. Astakhov The method of the boundary equations in problems of computing static and stationary fields on the topological graph	169
T. Kochubey, V. Astakhov The computation of magnetic field in the presence of ideal conductors using the Integral-differential equation of the first kind	171
M. Schneider, U. Lehmann, J. Krone, P. Langbein, Ch. Ament, P. Otto, U. Stark, J. Schrickel Artificial neural network for product-accompanied analysis and control	173
I. Jawish The Improvement of Traveling Responses of a Subway Train using Fuzzy Logic Techniques	179
Y. Gu, H. Su, J. Chu An Approach for Transforming Nonlinear System Modeled by the Feedforward Neural Networks to Discrete Uncertain Linear System	185
3 Optimisation and Management of Complex Systems and Networked Systems	
R. Franke, J. Doppelhammer Advanced model based control in the Industrial IT System 800xA	193
H. Gerbracht, P. Li, W. Hong An efficient optimization approach to optimal control of large-scale processes	199
T. N. Pham, B. Wutke Modifying the Bellman's dynamic programming to the solution of the discrete multi-criteria optimization problem under fuzziness in long-term planning	205
S. Ritter, P. Bretschneider Optimale Planung und Betriebsführung der Energieversorgung im liberalisierten Energiemarkt	211
P. Bretschneider, D. Westermann Intelligente Energiesysteme: Chancen und Potentiale von IuK-Technologien	217

Z. Lu, Y. Zhong, Yu. Wu, J. Wu WSReMS: A Novel WSDM-based System Resource Management Scheme	223
M. Heit, E. Jennenchen, V. Kruglyak, D. Westermann Simulation des Strommarktes unter Verwendung von Petrinetzen	229
O. Sauer, M. Ebel Engineering of production monitoring & control systems	237
C. Behn, K. Zimmermann Biologically inspired Locomotion Systems and Adaptive Control	245
J. W. Vervoorst, T. Kopfstedt Mission Planning for UAV Swarms	251
M. Kaufmann, G. Bretthauer Development and composition of control logic networks for distributed mechatronic systems in a heterogeneous architecture	257
T. Kopfstedt, J. W. Vervoorst Formation Control for Groups of Mobile Robots Using a Hierarchical Controller Structure	263
M. Abel, Th. Lohfelder Simulation of the Communication Behaviour of the German Toll System	269
P. Hilgers, Ch. Ament Control in Digital Sensor-Actuator-Networks	275
C. Saul, A. Mitschele-Thiel, A. Diab, M. Abd rabou Kalil A Survey of MAC Protocols in Wireless Sensor Networks	281
T. Rossbach, M. Götze, A. Schreiber, M. Eifart, W. Kattanek Wireless Sensor Networks at their Limits – Design Considerations and Prototype Experiments	287
Y. Zhong, J. Ma Ring Domain-Based Key Management in Wireless Sensor Network	293
V. Nissen Automatic Forecast Model Selection in SAP Business Information Warehouse under Noise Conditions	299
M. Kühn, F. Richter, H. Salzwedel Process simulation for significant efficiency gains in clinical departments – practical example of a cancer clinic	305

D. Westermann, M. Kratz, St. Kümmerling, P. Meyer Architektur eines Simulators für Energie-, Informations- und Kommunikations- technologien	311
P. Moreno, D. Westermann, P. Müller, F. Büchner Einsatzoptimierung von dezentralen netzgekoppelten Stromerzeugungs- anlagen (DEA) in Verteilnetzen durch Erhöhung des Automatisierungsgrades	317
M. Heit, S. Rozhenko, M. Kryvenka, D. Westermann Mathematische Bewertung von Engpass-Situationen in Transportnetzen elektrischer Energie mittels lastflussbasierter Auktion	331
M. Lemmel, M. Schnatmeyer RFID-Technology in Warehouse Logistics	339
V. Krugljak, M. Heit, D. Westermann Approaches for modelling power market: A Comparison.	345
St. Kümmerling, N. Döring, A. Friedemann, M. Kratz, D. Westermann Demand-Side-Management in Privathaushalten – Der eBox-Ansatz	351
 4 Intelligent Vehicles and Mobile Systems	
A. P. Aguiar, R. Ghabchelloo, A. Pascoal, C. Silvestre , F. Vanni Coordinated Path following of Multiple Marine Vehicles: Theoretical Issues and Practical Constraints	359
R. Engel, J. Kalwa Robust Relative Positioning of Multiple Underwater Vehicles	365
M. Jacobi, T. Pfützenreuter, T. Glotzbach, M. Schneider A 3D Simulation and Visualisation Environment for Unmanned Vehicles in Underwater Scenarios	371
M. Schneider, M. Eichhorn, T. Glotzbach, P. Otto A High-Level Simulator for heterogeneous marine vehicle teams under real constraints	377
A. Zangrilli, A. Picini Unmanned Marine Vehicles working in cooperation: market trends and technological requirements	383
T. Glotzbach, P. Otto, M. Schneider, M. Marinov A Concept for Team-Orientated Mission Planning and Formal Language Verification for Heterogeneous Unmanned Vehicles	389

M. A. Arredondo, A. Cormack SeeTrack: Situation Awareness Tool for Heterogeneous Vehicles	395
J. C. Ferreira, P. B. Maia, A. Lucia, A. I. Zapaniotis Virtual Prototyping of an Innovative Urban Vehicle	401
A. Wenzel, A. Gehr, T. Glotzbach, F. Müller Superfour-in: An all-terrain wheelchair with monitoring possibilities to enhance the life quality of people with walking disability	407
Th. Krause, P. Protzel Verteiltes, dynamisches Antriebssystem zur Steuerung eines Luftschiffes	413
T. Behrmann, M. Lemmel Vehicle with pure electric hybrid energy storage system	419
Ch. Schröter, M. Höchemer, H.-M. Groß A Particle Filter for the Dynamic Window Approach to Mobile Robot Control	425
M. Schenderlein, K. Debes, A. Koenig, H.-M. Groß Appearance-based Visual Localisation in Outdoor Environments with an Omnidirectional Camera	431
G. Al Zeer, A. Nabout, B. Tibken Hindernisvermeidung für Mobile Roboter mittels Ausweichen	437
 5 Robotics and Motion Systems	
Ch. Schröter, H.-M. Groß Efficient Gridmaps for SLAM with Rao-Blackwellized Particle Filters	445
St. Müller, A. Scheidig, A. Ober, H.-M. Groß Making Mobile Robots Smarter by Probabilistic User Modeling and Tracking	451
A. Swerdlow, T. Machmer, K. Kroschel, A. Laubenheimer, S. Richter Opto-acoustical Scene Analysis for a Humanoid Robot	457
A. Ahranovich, S. Karpovich, K. Zimmermann Multicoordinate Positioning System Design and Simulation	463
A. Balkovoy, V. Cacenkin, G. Slivinskaia Statical and dynamical accuracy of direct drive servo systems	469
Y. Litvinov, S. Karpovich, A. Ahranovich The 6-DOF Spatial Parallel Mechanism Control System Computer Simulation	477

V. Lysenko, W. Mintchenya, K. Zimmermann 483
Minimization of the number of actuators in legged robots using
biological objects

J. Kroneis, T. Gastauer, S. Liu, B. Sauer 489
Flexible modeling and vibration analysis of a parallel robot with
numerical and analytical methods for the purpose of active vibration damping

A. Amthor, T. Hausotte, G. Jäger, P. Li 495
Friction Modeling on Nanometerscale and Experimental Verification

Paper submitted after copy deadline

2 Advances in Control Theory and Control Engineering

V. Piwek, B. Kuhfuss, S. Allers
Feed drivers – Synchronized Motion is leading to a process optimization 503

M. Kaufmann / G. Bretthauer

Development and composition of control logic networks for distributed mechatronic systems in a heterogeneous architecture

INTRODUCTION

Information processing, plays an ever-increasing role in the functionality and quality of products in the field of mechanical engineering and becomes an inextricable part of the system function. However, program execution requires special hardware separated from the mechanical and electrical components. Typical hardware architectures in this domain are embedded systems (Micro controller, DSP board, micro processor, – with/without operating system), personal computer programmable logic controller (PLC) – and composed of several components: distributed systems with central supervisory control, distributed systems with distributed control, distributed autonomous cooperative systems. In many cases, a heterogeneous architecture consisting of diverse electronic units, software components, and communication interfaces is implemented (see Figure 1).

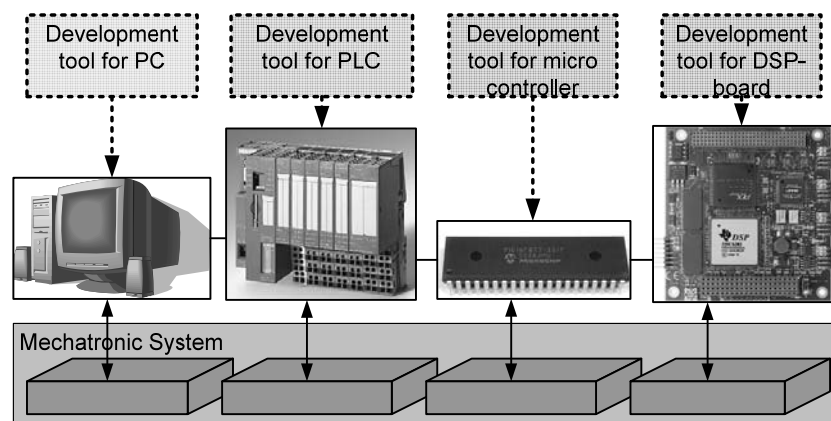


Figure 1: Mechatronic system with heterogeneous hardware and software architecture

Inside the different hardware units similar functional entities are executed – typically described by functional blocks. Among them are logical networks – consisting of logical operations, controllers – closed loop and open loop, various arithmetic operations, combinations of the aforementioned entities.

During the development of heterogeneous systems, different development tools using different standards, programming approaches and programming languages for basically similar functionalities are used. Developers make great efforts to verify functional consis-

tency of these systems, i.e. to test interoperation of entities developed by different tools. Especially for flexible systems of variable configuration procedures for test, verification and correction are passed through repeatedly. In this context functional consistency means: functional entities of the system cooperate in the desired manner and operate error-free. Depending on requirements, different aspects are considered and verified separately (see Table 1).

Table 1: Important aspects of functional consistency

Aspect	Remark
Data transfer between outputs and inputs of controllers and other function blocks,	Appropriate data connection, format and sequence
Hierarchical dependencies	Interoperation of several hierarchical layers
Failure management	Defined behavior in case of malfunction
Reliability, fault tolerance, FMEA [1]	Defined behavior to avoid damage in case of failure
Real time conditions, different cycle times	Compliance with real-time conditions
Concurrency, parallel operations	Appropriate sequence and interoperation of concurrent operations
Interlocking, enabling, priorities	Conditions and procedures for turn-on/turn-off
Different modes of operation	Switching between different operational states

Given the difficulties described above, an integration of all necessary tools into one comprehensive development suite would be desirable. Although comprehensive tools do exist for confined domains (see below), this approach is not practicable for heterogeneous systems in the foreseeable future. Hence, methods and tools for the assistance of design and verification of functional structures of information processing are necessary. The aim of this paper is to present an approach for a test-framework for functional consistency, applicable to a wide range of hardware and software, and to demonstrate the application to the development of an assembly machine [1].

TEST-FRAMEWORK FOR FUNCTIONAL CONSISTENCY

In computer science, the term data consistency model is used – among other meanings – to specify consistent access to data in a distributed system. In this regard, a number of possible data consistency models are known. A system supports a given consistency model if operations on memory follow a set of specific rules. The data consistency model specifies a contract between programmer and system, wherein if the programmer follows the rules, the system guarantees that memory will be consistent and the results of memory operations will be predictable. Accordingly, a functional consistency model (for a heterogeneous system) consists of a set of functional rules specifying conditions for connection and interoperation of functional entities of the system. If a functional structure – consisting of individual functional entities – follows the defined rules and is imple-

mented accordingly, the system is functioning failure-free and conflict-free.

In other domains where distributed hardware is used, comprehensive tools for integrated development have been implemented. For example, in process control engineering hardware and software architectures, functionalities, development tools etc. are standardized to a very large extent, see [2][3][4]. Open system standards are developed to further advance the flexibility and interchangeability of programs and hardware; see [5]. Due to this level of standardization, hardware manufacturers are able to provide integrated development tools covering the necessary range of verification. To cite another example, AUTOSAR (AUTomotive Open System Architecture) – developed by automobile manufacturers and suppliers – assists the development of networks of embedded systems in automobiles [6][7]. The AUTOSAR development framework supports the consistent distribution of functionality among several electronic control units.

The used consistency models in both domains – process control engineering and AUTOSAR – are tailored to the specific needs of supported hardware; implementation and programming are strongly supported. On the other hand, these consistency models are applicable to a narrow range of specialized hardware and software only and are mainly related to data transfer and interoperability of modules. An approach for a test-framework for functional consistency applicable to a wide range of hardware and software is presented in the following.

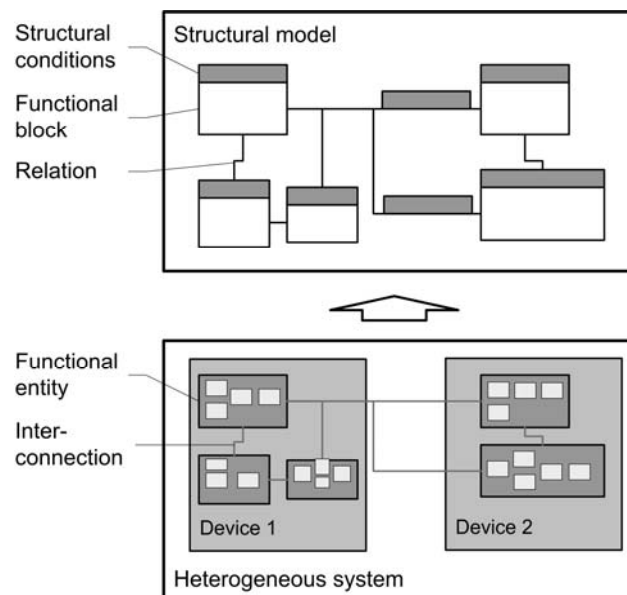


Figure 2: Structural Modeling

1. Structural Modeling: In the first step a structural model of the system is established for structural test purposes (see Figure 2). The structural model is composed of:

- Functional blocks representing the functional entities to be considered,

- Relations between functional blocks and
- Functional conditions.

Structural conditions are necessary conditions for interoperation between functional blocks to maintain functional consistency. Functional entities are – for example – controllers, pieces of control logic, arithmetic operations, data processing and supervisory control logic. The functional content of these system functions is *not* considered. Solely interfaces and relations between functional entities are taken into consideration – e.g. inputs and outputs, data transfer between entities, hierarchical relations, enabling and causal dependencies. Depending on the considered perspective, different information is incorporated. Functional blocks are connected by relations. Relations describe data transfer as well as the existence of functional dependencies between blocks. The type of dependency as well as interactions between functional blocks is described by functional conditions, e.g.: “B can be activated only if execution of A is completed”. A sample controller type block with hierarchical interconnections is given in Figure 3.

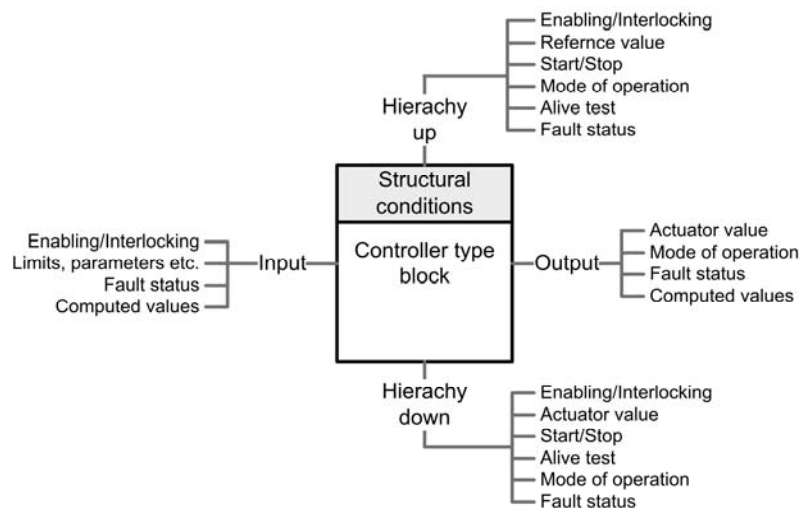


Figure 3: Sample controller type block with hierarchical interconnections

2. Consistency model and structural test: To define a consistency model, structural rule sets are defined for different aspects. Structural rules describe conditions and restrictions for consistency regarding a specific test aspect. For different test cases – e.g. failure management – several rule sets are arranged (see Figure 4). The structural rules are independent of the functional blocks, relations and functional conditions. The following rule exemplifies the possible content of structural rules: “A functional block A can be executed only if all functional blocks transferring inputs to A have been executed.”

A structural verification is accomplished by testing the structural model systematically for compliance with rules of one or more rule sets.

3. Application of results: As result of the structural verification inconsistencies are indi-

cated. In the third step the developer turns to system design again and eliminates the conflicts; results are incorporated in software coding. This procedure of test and re-design/re-programming is repeated until consistency is established.

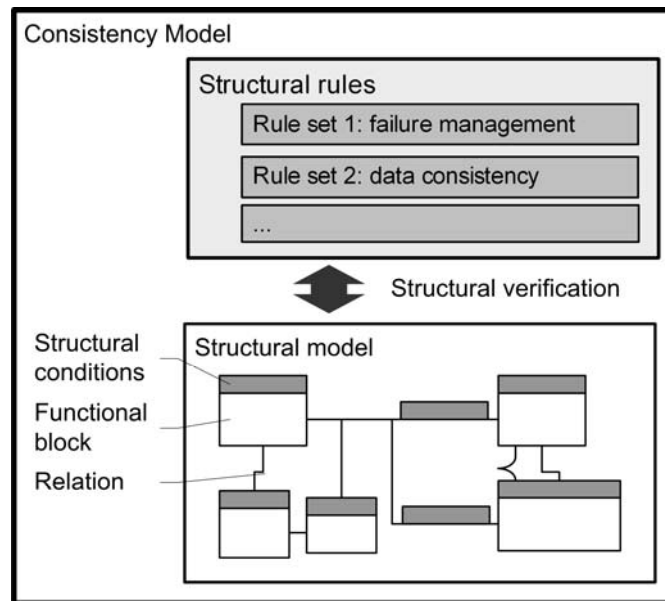


Figure 4: Consistency Model

SAMPLE APPLICATION

A section of the information processing of a servo driven assembly machine in symbolic form is given in Figure 5. It consists of equipment of heterogeneous architecture; functionality is finally coded using different tools. In the modeling of the functional structure, all functional units – e.g. controllers, interlocking logic, fault detection logic, data processing – are transformed to abstract standard blocks with specific interfaces, see Figure 6. In this process, only logical interconnections are considered, algorithms behind the blocks are not regarded. The resulting structure of connected standard blocks is used to analyze and optimize the interoperation of the blocks.

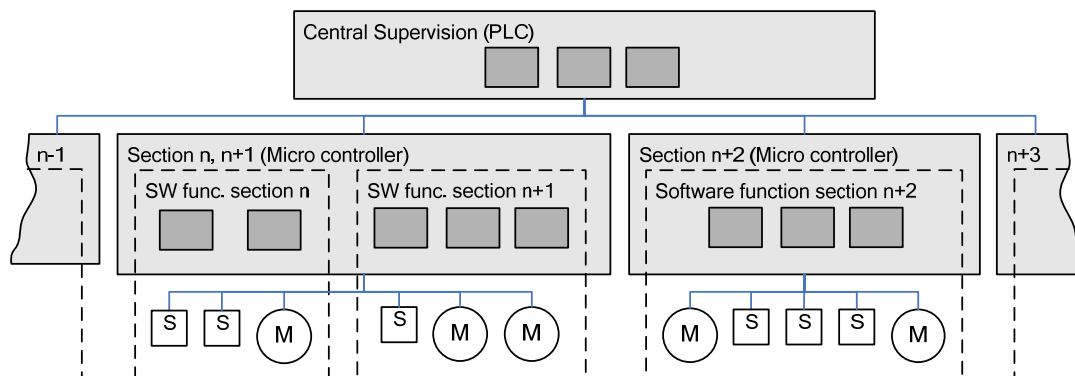


Figure 5: Servo driven assembly machine (M: Servo drive, S: Sensor)

This approach is used to eliminate fault conditions in the interaction between sections of the assembly machine [1]. The structural test based on the structural model reveals in-

consistencies – e.g. incorrect sequences, exceeded time limits. Functional entities can be changed accordingly. The automatic structural test eliminates the time-consuming, error-prone manual check of the structure. At present, a semi automatic test environment is established in order to develop modelling and test methods.

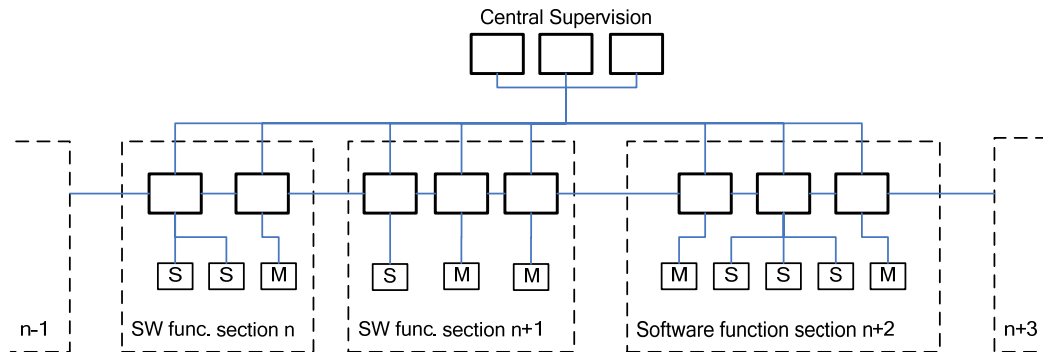


Figure 6: Model of the functional structure

CONCLUSION

Heterogeneous architectures of mechatronic systems require approaches for comprehensive structural tests during system design. Structural modeling of the system is used to create an automatic environment for device- and manufacturer-independent checking regarding different perspectives. This approach is used to check the failure management and start/stop-sequence/interlocking of an assembly machine composed of several assembly stations. Further work is necessary to extend the approach to more test perspectives and device combinations, to develop an uniform description method for functional blocks, relations, conditions and to develop a practicable software solution.

References:

- [1] Lorch, M.: Machbarkeitsanalyse eines neuen Antriebskonzeptes für einen Längstaktmontageautomaten mit hoher Taktzahl. Diplomarbeit, Universität Karlsruhe (TH), 2007.
- [2] DIN EN 61499-3. Funktionsbausteine für industrielle Leitsysteme, Teil 3: Programmiersprachen. Berlin: DIN Deutsches Institut für Normung e.V., 2006.
- [3] DIN EN 61131-1: Speicherprogrammierbare Steuerungen, Teil 1: Architektur. Berlin: DIN Deutsches Institut für Normung e.V., 2003.
- [4] DIN EN 61499-2. Funktionsbausteine für industrielle Leitsysteme, Teil 2: Anforderungen an Software-Werkzeuge. Berlin: DIN Deutsches Institut für Normung e.V., 2006.
- [5] PLCopen, Gorinchem, NL. <http://plcopen.org/>
- [6] Heinecke, H., Bielefeld, J., Schnelle, K.-P., Maldener, N., Fennel, H., Weis, O., Weber, Th., Ruh, J., Lundh, L., Sandén, T., Heitkämper, P., Rimkus, R., Leflour, J., Gilberg, A., Virnich, U., Voget, S., Nishikawa, K., Kajio, K., Scharnhorst, Th., Kunkel, B.: AUTOSAR – Current results and preparations for exploitation. 7th EUROFORUM Conference 'Software in the vehicle' 3-4 May 2006, Stuttgart, Germany.
- [7] AUTOSAR GbR, München, <http://www.autosar.org>

Authors:

Dr.-Ing. Michael Kaufmann
 Prof. Dr.-Ing. habil. Georg Bretthauer
 Universität Karlsruhe (TH), Institut für Angewandte Informatik/Automatisierungstechnik (AIA),
 Kaiserstr. 12, Bldg. 10.91, R. 203
 76131 Karlsruhe, Germany
 Phone: +49 (721) 608-7971
 Fax: +49 (721) 608-7972
 E-mail: [Michael.Kaufmann, Georg.Bretthauer]@aia.uni-karlsruhe.de